Wonders of Wireless Telephony—Past and to Come

The Most Astonishing Feat of All, Our Army Officers Talking Wirelessly With Aviators Flying in Battle

By J. Olin Howe

TALKING TO EARTH WHILE HE FLIES
With a wireless transmitter that is deaf to everything but the aviator's voice

"A PRETTY PICTURE, that of every one with a wireless telephone outfit in office or home and each individual able at any time to talk with any other by simply calling through the air. Jules Verne could doubtless have done a great deal with such an idea—in a book—but when it came down to the practical application of it, that would be quite another thing. The radio telephone is essentially not secret and is subject to malicious disturbances. It is also subject to static disturbances and, therefore, by no means commercially dependable, and the number of messages which can be handled in a given area is very limited.

"No, the wireless telephone will hardly take the place of the wire telephone—at least, until there are changes so radical as to alter completely the scheme of radio communication as we know it today. To be sure, it is dangerous to prophesy what can or cannot be accomplished at a time when epoch-making developments are crowding so hard upon one another. Yet the notion of everybody having his own small radio telephone plant and calling at will any one with whom he or she might desire to talk is summarily disposed of by existing fundamental conditions. We shall continue to be obliged to depend upon wires for telephone communication except as the radio telephone may supplement the wires under special circumstances."

The speaker was Dr. Frank B. Jewett, chief engineer of the Western Electric Company, a scientist of most attractive personality, whose name means much in radio and telephone circles and far outside. He is just out of the army, where, as a colonel in the signal corps, he was responsible for the creation of the radio telephone for airplanes and of that by means of which the navy talks to ships at sea and directs the movements of its submarine chaser flotillas.

We were discussing the establishment of radio telephonic communication between Newfoundland and Ireland by the British Marconi Company. Sitting there in Dr. Jewett's sightly offices, high up in the West Street building, overlooking the varied shipping which passed up and down the Hudson fairway, even observing the Nieuw Amsterdam as she backed out into the stream from Hoboken with Eckhardt, the German Minister to Mexico, and his staff aboard, these matters seemed not so far out of the everyday as they really are. Think for a moment what it means to send the tones of the human voice far out into the atmosphere upon a Hertzian wave.

Things Done Already

Talking thus from Newfoundland to Ireland actually isn't so remarkable a thing, however. In this country Arlington long since talked to the Panama Canal zone and the Mare Island naval station in California by radio wireless. More, the powerful station opposite the City of Washington three years and a half ago flung the vibrations of the human voice as far as the Hawaiian Islands and even to the Eiffel Tower in Paris, and wire telephone lines at either end were connected up and used in combination with the wireless.

Dr. Jewett and his assistants, among the more prominent of them Edward B. Craft and E. H. Colpitts, assistant engineers, have done even greater marvels in radio telephony between ships and between ship and shore, and, most wonderful of all, between this solid old earth and the soaring airman high in the heavens.

To devise a receiver, and especially a transmitter, which would exclude from the radio line, so to call it, all the roar of the airplane's mighty engine and the rush and tumult of the winds of the world and take in only the tones of the voice—there was an accomplishment worth celebrating. Only now that the war is over are we permitted to know about this.

"It is not surprising," Dr. Jewett went on, "that what is becoming known now of radio telephone experiments should arouse keenest public interest in the subject. People generally want to know what place radio telephony is likely to have in the future communication systems of the world. It is going to have a place, an important place, but we must look at it as it is accurately to realize what that place is to be. Many of the recently published results have been the direct outgrowth of war conditions, but some are the outcome of work only remotely connected with specific war problems.

"The whole question of radio telephony, both present and future, is, of course, very intimately associated with conditions which underlie the art of radio telegraph communication. From a physical standpoint it seems quite clear that whatever limitations are imposed by nature on wireless telegraph operations are imposed equally on wireless telephone operations. There are also many additional limitations which apply to radio telephony with greater force than to radio telegraphy.

"On the other hand, there are certain limitations, largely of the human character, which apply with greater force to radio telegraphy than to radio telephony. Principal among these is the necessity for specially trained operators where radio telegraph operation is involved.

A Product of Recent Years

"While the idea of radio telephony as a means of communication is practically as old as the art of radio communication, it is only within the last few years that any substantial progress has been made. The early developments in radio communication involved electrical systems which were inherently unsatisfactory for any kind of radio telephony and no progress at all could be made until the art had developed to such a point that satisfactory continuous wave methods of transmission were available. Following this fundamental development, it was further necessary to devise the mechanism required at the transmitting stations to permit of voice control of the energy transmitted through the ether in the form of a continuous wave train and the further mechanism required at the receiving station to detect and reproduce as intelligible speech in an ordinary telephone receiver the energy received from the distant transmitting station.

"Since all radio systems for use over any considerable distance involve an amount of energy at the transmitting station many hundred or thousand times greater than the energy normally employed in ordinary wire telephony and since, on the other hand, the amount of energy available at the receiving station is but a small fraction of that required for the proper operation of a telephone receiver under conditions of commercial operation, the problems up for solution were extremely difficult, even after the fundamental requirements were quite clearly formulated.

"In the seven or eight years immediately prior to 1914 numerous experiments in radio telephony were made, largely by American inventors and engineers, and results of considerable promise were obtained. None of these experiments, which were principally confined to relatively short distances, resulted, however, in the production of a commercial radio telephone system. In 1914 and 1915, following the work which resulted in the establishment of transcontinental wire telephony between the Atlantic and Pacific coasts, the engineers of the Bell system produced the apparatus which in the summer and fall of 1915 resulted in those demonstrations of long distance radio telephony which were given such prominence in the public press at the time.

"As will be remembered, these demonstrations, which were made with the cooperation of the United States Navy, resulted in the establishment of successful radio telephone communication from the navy towers at Arlington, Va., with the naval stations at Panama, Mare Island, in San Francisco Bay; San Diego and Honolulu, and in the early fall of 1915, through the courtesy of the French government, to the military station in the Eiffel Tower at Paris. As a part of these experiments, all of the mechanism and methods required to interconnect wire and wireless telephone links in a continuous communication train were worked out and demonstrated.

Fitting the Thing to War

"Almost immediately following these experiments the energies of the Bell system engineers, and particularly those of the Western Electric Company, were directed to the solution of radio telephone problems of military importance. These problems were initially those of the navy, the officers of which early appreciated the possibilities of this new form of communication. At a later date the problems of the army received a large amount of attention. In particular, those problems which related to radio telephone communication to, from and between airplanes became matters of the greatest moment.

"'Because of the knowledge of the work previously done the chief signal officer of the army early in 1917 assigned to the engineers of the Western Electric Company the difficult problem of developing radio telephone communication for airplanes and this work was successfully completed before the end of that year, with the result that large quantities of commercial radio telephone apparatus were constructed for both the army and the navy.

"In order to have a proper basis for deciding as to the probable future of radio telephony, there are certain fundamental facts which should be clearly understood.

"Principal among these are the physical processes involved in it, the limitations imposed by nature on all radio communication, the extent to which secrecy and freedom from interference are essential to commercial communication and the extent to which the field of radio communication must be reserved for those classes of communication which in the present state of the art can be conducted in no other way or which must be reserved for military purposes in connection with the national defence.

"All radio communication consists in sending out from the transmitting station a large amount of energy in the form of electro-magnetic waves and receiving a very small amount of this energy on the wires of the receiving station. That the amount of energy available at the receiving station is but a minute fraction of the energy which starts from the transmitting station can be appreciated when it is realized that the electro-magnetic waves radiate from the transmitting station in all directions and that only that part of the initial energy which can be picked up by the wires of the receiving station is available there.

"The minuteness of this received energy renders all radio communication very susceptible to interference from natural electrical disturbances and from other radio stations.

A Tough Technical Problem

"In radio telephony the problem is still further complicated by the fact that the continuous wave train which would serve as the basis for a radio telegraph channel is required to perform the additional burden of acting as the carrier for the voice waves. Since all radio communication employs the same common conductor and since freedom from interference between messages is dependent solely upon the ability to use a different range of frequencies for each message, this added condition greatly broadens the band of frequencies required for a radio telephone message as distinguished from a radio telegraph message and very greatly limits the number of non-interfering conversations which can be sent or received from a given area."

The scientist so recently an army officer stopped a moment. "Do you realize what that means?" he asked. "Wireless offers no panacea for our telephone troubles. Why, so limited is the number of non-interfering radio telephone messages possible from a given area in the present state of the art that this alone would render it impossible to handle more than a very small fraction of the normal telephone business of the City of New York. Even employing the latest methods of multiplex wire transmission, as is done in radio telephony, wouldn't help in this.

"More important even than interference from other radio stations," Dr. Jewett continued, "are the questions of natural interference and non-secrecy. Because of the fact that all radio communication employs the same medium of transmission it is, of necessity, essentially non-secret, and any one possessed of the requisite apparatus can easily receive the messages from any desired station. This is particularly true of radio telephony, where even that form of secrecy made possible by the use of codes is difficult to obtain. Further, the broad band of frequencies required to cover the speech range makes it easy to tune in any station to receive.

"Then there is the matter of natural disturbances," he said, "and without attempting to judge of the value of the recent static eliminators which have been announced, it is sufficient to say that the so-called static disturbances have thus far proved the most serious bar to reliability in all radio communication and that great difficulties must be overcome under certain conditions if anything like the continuous service called for in an operating telephone plant is to be obtained.

Dr. Frank B. Jewett
The man who knows wireless telephony

"From a physical standpoint the state of the radio telephone art since 1915 has been one in which it was possible under certain conditions and at certain times to telephone between two ordinary telephone instruments located at widely distant points on the earth's surface and to do this either wholly by radio or by a combination of any number of wire and radio links. Prior to the middle of 1917 this communication would have been limited to telephone stations located either on land or sea. Thanks to the developments of airplane radio, however, it is now possible to include telephone stations located above the earth's surface in the general communication area. Yet it has not been and is not now possible to give a widely extended and reliable general radio telephone service.

"As matters stand, what then is the probable future of radio telephony and to what extent, if at all, is it likely to supersede wire telephony? That is what the average man wants to know. He gets his answer in this, that there are certain classes of telephonic communication which can be accomplished at present in no other way than by wireless.

"These classes are between ships at sea, between ships and the shore, from the earth to 'planes in the air and from 'plane to 'plane, and between points on land which are separated by regions, whether water or land, across which it is impossible or impracticable to erect and maintain wire telephone lines. By this I do not mean across the Atlantic or Pacific oceans. The moment an effort was made to establish commercial service between New York and London, for instance, all the difficulties to which I have referred would complicate the situation.

Counting The Cost

"The initial cost of a station on Long Island, for instance, and at some feasible point in England, would be less than that of laying the Atlantic cable, but that of upkeep and operation would be far greater; the wireless telephone could not be depended upon, as business men must depend on their means of communication, and it could not handle the volume of business which would be offered or anything approaching it.

"No, what I mean by regions to which a wire circuit is impossible or impracticable is illustrated by the Canadian government's plan to provide telephone communication with the Peace River Valley by radio. A local wire line in that isolated section can be built and maintained to distribute the calls which are sent over the intervening wastes by wireless.

"For radio telephony, as, indeed, for all forms of radio communication outside the realm of war, there seems to be little doubt that the developments of the future will be in the direction of apparatus and methods to extend and supplement existing wire service. There is no present indication of any radio developments which will supplant or even curtail the use of wires for either telephone or telegraph operation."

As he said this Dr. Jewett directed my attention out one of the great windows which give on the river and the Jersey hills beyond. Out there in the air, making their steady progress through their element up river, and looking like nothing so much as two huge wild ducks, were a couple of seaplanes, flying boats, possibly tuning up for the transatlantic flight. The thought of actually talking with those aviators from that room, as we could have done had their coming been known long enough ahead to make the arrangements, gave me something of the uncanny sensation that a long distance telephone connection always does.

"You ought to read what Mr. Crafts has written about how the aircraft production boards and the joint army and navy technical boards were introduced to radio telephonic communication with airplanes at Dayton," said Dr. Jewett, as he got Mr. Crafts' article for me. It was worth reading. Here is part of it:

A Heart-Breaking Struggle

"It would take volumes to describe the innumerable experiments and heart-breaking failures before the first real successes," says the engineer. "At length a head set inside an aviator's helmet was designed, which would exclude the noise of the airplane's engine and of rushing air. A brilliant line of experimentation, largely at the hands of J. P. Minton, resulted as well in a transmitter or microphone, which possessed the remarkable quality of being insensitive to engine and wind noises, and at the same time very responsive to the tones of the voice. Then three solid months of the hardest kind of work was necessary to iron out all the kinks and get the thing in shape, so that it might be considered a practicable device for the everyday use of other than experts.

"Finally in October, 1917, we reached the point where we thought it was time to spring it on the A. E. F. and accordingly Colonel Culver was sent abroad with several trunkloads of the apparatus to show our people overseas that we had not been asleep on the job and had a new tool for their use. In early December the next historical event took place. To those of us who were mixed up in this little affair those were three days which we will never forget. Colonel Carty and Colonel Jewett were in the party, which was made up of admirals, generals, foreign representatives and experts galore, all willing to be shown but decidedly skeptical.

"It must be remembered that the idea had not yet been told to any but the wild enthusiasts who had been living with the job for the last six months. Pilots are, to say the least, fussy about what is loaded into the 'planes they are to fly, to say nothing of the trailing wires which serve as antennæ. Designers and constructors hold much the same view, so it took a lot of manœuvring and diplomatic jockeying to get our stuff aboard and into the air. Finally, just about dark on the evening before the fatal day we did get one machine into the air and found that the apparatus worked.

"The plan was to have two 'planes in the air at once and for the official party to listen in at a ground station located on the top of a hill near the field. That night we all congregated in one of the rooms of the hotel, worked out our scenario and held a rehearsal. I must confess that I didn't sleep very well that night. Next day we were out at the field bright and early, fussing around trying to keep busy until it was time for the big show. Upon arrival of the exalted ones we showed them the apparatus in the 'planes and explained what it was expected to do.

"They went up to our little station on the hill, where we had rigged up a loud-speaking receiver connected to the wireless apparatus so that all could hear without the use of lead sets. The 'planes left the ground and after what seemed an interminable length of time we got the first sounds in the receiver which indicated that they were ready to perform. The spectators were only mildly interested and some seemed a bit bored.

First Words From the Air

"Suddenly out of the horn of the loud-speaker came the words, 'Hello, ground station. This is 'Plane No. 1 speaking. Do you get me all right?" The bored expression immediately faded and looks of amazement came over all their faces.

"Soon we got the same signal from No. 2 and the show was on. Under command from the ground the 'planes were manœuvred all over that part of the country. They were sent on scouting expeditions and reported what they saw as they travelled through the air. Continuous conversation was carried on, even when the 'planes were out of sight, and finally upon command they came flying back out of space and landed as directed.

"From that moment the radio telephone was sold."

Record Enthusiasts—Categorically Considered

By Pearl Spaulding

IN AN unguarded moment a Phonograph-Record Expert, who had spent several years in catering to the musical taste of record buyers, once remarked that they were divided into two distinct classes—those who liked "The Rosary" and those who did not.

Later he became even more confidential in the classifying of various types of record enthusiasts and how to know them. One of the delicate requirements of the salesman himself, it seems, is to become so proficient in taking a mental measure of his customer that he can tell by such subtle means as the flicker of an eyelash whether he is about to ask for an operatic or a yodel selection.

Of course, there are those whose taste in music cannot be gauged by their appearance or even by their professional reputation. Such was the actual case of a well known opera singer who had never been known to purchase anything but ragtime besides the records he had made himself.

Then there is the Record-Connoisseur, whose knowledge of the catalogue extends from cover to cover. In search of the Perfect Record he insists upon hearing a half dozen records (*exactly alike*) of the selection he desires to purchase, examining his final choice with a painstaking eye that no lurking defect may escape him. Of such a one as this did an anxious wife write to the proprietor of the record shop: "Please do not sell my husband any more records until he pays for what he has!"

The Weary Feminine Shopper is another omnipresent type. Usually of portly dimensions and laden down with bundles, she views the record booth as a sanctuary of rest and, sinking heavily into the nearest easy chair, murmurs: "Play—me—something—nice!" Doubtless Nevin had in mind a mental picture of her when he penned the immortal line, "The hours I spent with thee, dear heart."

The Record Expert sighed heavily in retrospect. Then his face brightened. "I omitted to say that occasionally there is a heaven-sent purchaser who likes *all* the records I select and who takes them with her to Timbuctoo or some out of the way place where she can't send them back to be exchanged!"

TALKING ACROSS SPACE TO A FLIER
The Wireless telephone plant used by ground officers during the late days of the war.